Shrimp

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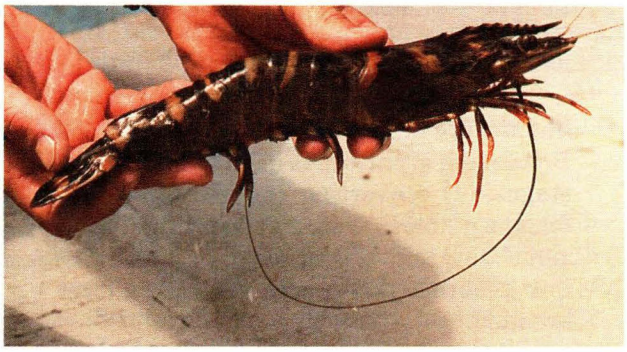
Department of Agricultural and Resource Economics
College of Tropical Agriculture and Human Resources
University of Hawaii

By
Kevin M. Yokoyama, Stuart T. Nakamoto,
and Kulavit Wanitprapha



Courtesy of Aquaculture Development Program

CULTURED SHRIMP

SPECIES

- *Penaeus monodon* (black tiger), *P. chinensis* (Chinese white), and *P. vannamei* (Western white) are three shrimp species that together account for over 70% of the world's cultured shrimp production.

- *P. monodon* is extensively cultured in Southeast Asia. This species, which can withstand high temperatures and low salinity, is the fastest growing and the largest of the farm-raised shrimp. It can reach a maximum length of 13 in.

- *P. chinensis* is cultured primarily in China, where it accounts for 90–95% of the total farmed production. It grows at a lower temperature than *P. monodon* and reaches a length of 6 in within five months.

- *P. vannamei* is a popular cultured species in Latin America. It has a uniform growth rate and obtains a maximum length of 9 in. This species has a lower protein requirement than *P. monodon* and *P. chinensis*, and appears to be immune to some shrimp viral diseases.

PRODUCTIVITY

- After juvenile shrimp are stocked in a growout operation, it takes three to six months to produce shrimp to a marketable size. Water temperature limits the number of crops that can be grown per year. In temperate environments, one or two crops are obtained per year, but in warm water areas three crops are possible.

- There are three types of shrimp growout methods: extensive, semi-intensive, and intensive. Each technique can be characterized by the stocking density, with the intensive method having the highest density. An increase in density requires more sophisticated technology such as formulated diets, aeration, and intensive water-management schemes.

- Annual yields are highly variable among the growout approaches: 110–1100 (head-on) lb/ac for the extensive method, 1100–13,200 lb/ac for the semi-intensive method, and about 22,000 lb/ac per year for the intensive method. A new method, "super intensive" shrimp farming, may produce yields as high as 110,000 lb/ac per year.

- Due to the increased control the producer can exercise, shrimp aquaculture has some advantages over trawler harvesting because the timing to harvest and shrimp sizes can be coordinated with the most favorable market conditions.

- Polyculturing shrimp with oysters in well-aerated ponds may increase revenues while reducing feed input requirements. Besides the additional revenues from selling oysters, the ex-

Species	% of Total Farmed Production	Selected Producing Country/Region
Penaeus monodon	33%	India, Southeast Asia, Taiwan
P. chinensis	22%	China, Korea
P. vannamei	18%	Ecuador, Colombia, Mexico, Panama, U.S.
P. penicillatus	8%	South America
P. merguiensis	4%	Indonesia, Taiwan, Japan
P. japonicus	3%	Japan, Taiwan, Korea
P. stylirostris	2%	Ecuador, Colombia, Mexico, Panama, U.S.
Others	10%	

pected conversion of phytoplankton to feces and pseudofeces may save on shrimp feed.

PRODUCTS

- Shrimp are marketed in a wide variety of forms. Processing of shrimp is usually divided into two stages: (1) converting raw shrimp into frozen form, e.g., block frozen or individual quick frozen (IQF), and (2) transforming frozen shrimp into a more highly processed product form, e.g., breaded.

- Shrimp is generally believed to be high in cholesterol. However, a 3.5-oz serving of shrimp contains about 140 mg of cholesterol, compared to 315 mg in a large egg yolk. Shrimp also contains some omega-3 fatty acids, which have gained attention for possibly protecting against coronary disease.

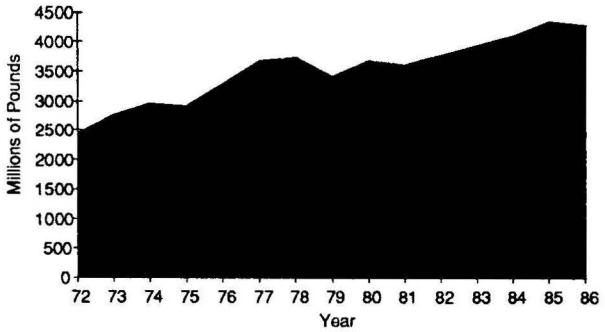
- Imitation shrimp has entered the market to compete with the natural product. Shrimp is also blended with lobster and fish to produce imitation lobster.

WORLD SUPPLY AND DEMAND

SUPPLY

- Shrimp aquaculture is becoming more important, while shrimp landings from capture fisheries are believed to be reaching their limit. In 1988, it was estimated that 990 million lb (head-on) of cultured shrimp were harvested, accounting for 22% of the total world shrimp supply for the year. The major producers were China (22% of the total), Ecuador (16%), Taiwan (11%), Indonesia (11%), and Thailand (9%).

- World cultured shrimp production is expected to continue growing. China plans to double production every three years, and Mexico and Brazil have considerable potential to become major producers due to the vast amount of suitable coastal lands for shrimp farms. Shrimp aquaculture can be risky, however: Taiwan's 1988 production was cut almost in half, and the cause is unclear.



World Shrimp Production

- Shrimp farming production costs can vary considerably among different producing countries. In China, the average production costs were estimated at $1/lb (tail weight), compared to $1.90 to $2.50 in Taiwan and $1.50 to $1.75 in Thailand.

- Shrimp prices vary according to a wide variety of factors including size, supply, quality, origin, and species or color. INFOFISH trade news provides price information on various species by size, country, and market.

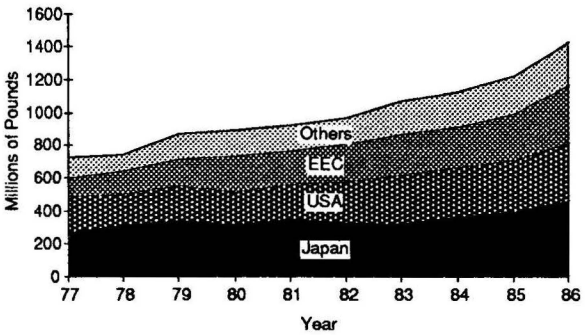
IMPORTS

- World shrimp imports increased 95% from 733 million lb in 1977, at a value of $1.6 billion, to 1.4 billion lb in 1986, at a value of $4.4 billion. Most shrimp are imported in frozen form.

- Japan and the United States are the world's two largest shrimp importers, together accounting for 58% of the total shrimp imports in 1986. Other major markets are Western European countries, Hong Kong, Singapore, and Canada.

- Between 1977 and 1986, the European Economic Community imports of shrimp rose at an average annual rate of 13.5%, about twice the rate in Japan and the United States. Leading importing countries in the EEC are Denmark, France, and the United Kingdom.

- Traditionally, producing countries export most of their shrimp to the nearest major market. This situation may be changing due to the increase in competition from the expansion of shrimp farming activities. For instance, China has recently surpassed Ecuador as the primary supplier to the United States.



World Shrimp Imports

SELECTED MARKETS

THE UNITED STATES

- Per capita consumption of shrimp in all product forms reached a record high of 2.3 lb/person in 1987, an increase of 53% from 1978.

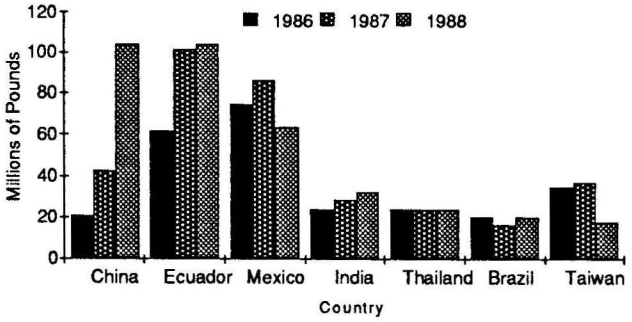
- In 1988, about 2.2 million lb of whole shrimp (1.4 million lb head-off weight) were farmed in the United States. Most were produced in Texas and Hawaii, with some in South Carolina.

- Since shrimp aquaculture is limited and the supply from commercial landings has been unstable, the United States has become more dependent on imports to sastify the growing demand for shrimp. Over the period 1978–87, U.S. commercial landings of shrimp fluctuated between 156 million lb (head-off weight) and 257 million lb, while imports increased from 240 million lb in 1978 to 583 million lb in 1987.

- In 1988, shrimp imports reached a record level of 598 million lb (head-off weight). Major suppliers were China (21% of the total), Ecuador (21%), Mexico (13%), India (6%), and Thailand (5%). About 71% of shrimp imports were raw shell-on shrimp, 19% were raw peeled shrimp, and the remainder were canned, breaded, and other product forms.

- The "Directory of the United States" published by the Journal of Commerce lists over 80 importers of shrimp. The most common method of importing shrimp is outright purchase by an importing firm. Other methods are through an intermediary on a consignment basis and by an agent on a commission basis.

- About 75% of shrimp are consumed in restaurants and other eating establishments outside the home. The remaining supply is sold through retail outlets, primarily supermarkets, and directly from fishermen to the consumers.



Major Suppliers of Shrimp to United States, 1986–88

- Some shrimp are processed into value-added items such as breaded shrimp, shrimp burgers, and stuffed shrimp. More than 250 processors of various shrimp products are listed in the "Annual Processors Directory and Buyer's Guide" published by Quick Frozen Foods.

- There are regional preferences for shrimp. White shrimp (e.g., *P. vannamei*) are preferred on the Pacific coast and in the Northeast, pink (e.g., *P. brasiliensis*) in the Southeast, and brown (e.g., *P. aztecus*) in the Midwest. Black tiger shrimp has faced some market resistance due to its thick shell and dark shell stripes, which have been incorrectly construed by some consumers as the early stages of decomposition.

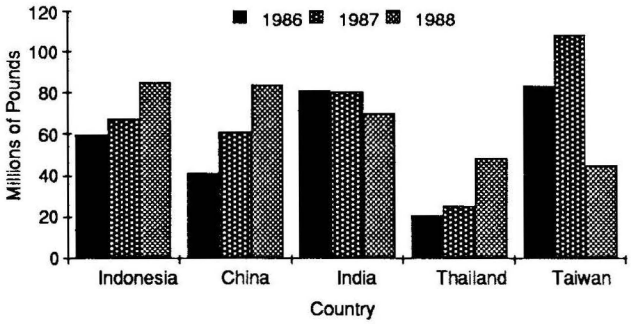
- Various sized shrimp are used differently. Shrimp sized 21/25 (number of shrimp/lb) and larger are used in high priced restaurants as main dishes. Medium (26/30 to 41/50) and small (51/60 to 71/80) shrimp are often used by family-style restaurants and shrimp breaders, and are marketed through retail outlets. Smaller shrimp (80/over) are commonly used by processors as peeled meat.

JAPAN

- The average annual per capita consumption of fish and shellfish was 164.2 lb (liveweight equivalent) between 1982 and 1984, second highest in the world. Per capita consumption of shrimp is estimated to be almost twice that of the United States.

- A shortage of suitable land and poor shrimp-growing climate limits shrimp farming activities in Japan. In 1988, the farm production was approximately 6.6 million lb of whole shrimp.

- Japan imports a large quantity of shrimp to meet the strong demand. In 1986, domestic landings were about 120 million lb (product



Major Suppliers of Shrimp to Japan, 1986–88

weight), while imports accounted for 468.9 million lb.

- In 1988, Japan imported 568 million lb (product weight) of shrimp, a significant increase from the 327 million lb imported in 1983. Major suppliers include Indonesia (15% of the total), China (15%), India (12%), Thailand (8%), and Taiwan (8%).

- Import trading companies control the largest share of shrimp imports. These firms possess substantial financial resources, enabling them to secure supplies by entering into joint ventures and making preseason advances to producers. Major trading firms include Mitsui and Co. Ltd., Mitsubishi Corp., Marubeni Corp., and C. Itoh and Co.

- Raw, headless, shell-on shrimp is the most popular form among traders, representing roughly 70% of the total volume traded. Other commonly traded product forms include peeled shrimp, head-on shrimp, and live shrimp.

- Most of the shrimp are consumed outside the home. At least 75% of the shrimp are consumed in restaurants and other dining places.

- The major farmed species and the most highly prized shrimp in Japan is *P. japonicus*. Department stores sell this species live as an expensive gift item; it is also the best and most expensive shrimp used in sushi shops. This shrimp is also imported live from Taiwan, Korea, and Brazil.

- A wide variety of shrimp species is used in Tokyo. However, in the southern part of Honshu white shrimp are preferred, while in Osaka and Kyoto black tigers are commonly used. Black tiger shrimp has become popular for its brilliant reddish color after cooking.

- Large shrimp (15/under) are served in upscale restaurants and hotels. Shrimp sizes 16/20, 21/25, and 26/30 are commonly used for tempura and sushi. Smaller sizes (31/35 and over) are often sold through retail outlets, and are used by processors and noodle-makers for various prepared foods.

SHRIMP AQUACULTURE IN HAWAII

- The value of Hawaii's aquaculture industry was estimated at $18.2 million in 1988, up from $16.5 million in 1987. The service sector, which includes research, training, conferencing, and consulting, generated most of the revenue ($12.7 million), while the commercial production sector accounted for only $5.5 million (farmgate value).

- In 1988, 563,000 lb (head-on) of farmed shrimp were produced at an approximate farmgate value of $2.5 million. There were eight shrimp operations: five were commercial enterprises (two of which were rebuilding) and three were research operations. *P. vannamei* and *P. monodon* are the species currently being farmed.

- The size of the commercial shrimp enterprises varies considerably, from 1 ac to over 100 ac. Yields also greatly differ among farms, ranging from approximately 5000 to 30,000 lb/ac. Using super-intensive techniques, one firm was able to obtain a yield of 100,000 lb/ac by growing *P. stylirostris* in raceways under greenhouses before the infectious haematopoietic and hypodermal necrosis (IHHN) viral attack devastated the operation.

- In a 1986 survey of Hawaii's commercial aquaculture industry, high production cost (e.g., labor rates, feed, electricity) was the major factor limiting shrimp production. Other constraints were lack of capital, difficulty in producing a consistent supply of postlarvae, and disease.

- The Philippines is supplying a substantial amount of shrimp to Hawaii. Imports of shell-on shrimp directly from the Philippines to Hawaii increased over 100 times from 3699 lb in 1981 to 376,748 lb in 1986.

- A by-product of sugarcane production (bagasse) could be used as shrimp food in semi-intensive operations. The estimated cost of bagasse food was $100 per ton in experimental trials, considerably lower than the $300 to $450 per ton for commercial shrimp feed.

- A source for a wide variety of information about aquaculture is the Aquaculture Development Program of the State Department of Land and Natural Resources.

Hawaii Agricultural Experiment Station, HITAHR, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa. Noel P. Kefford, Director and Dean.